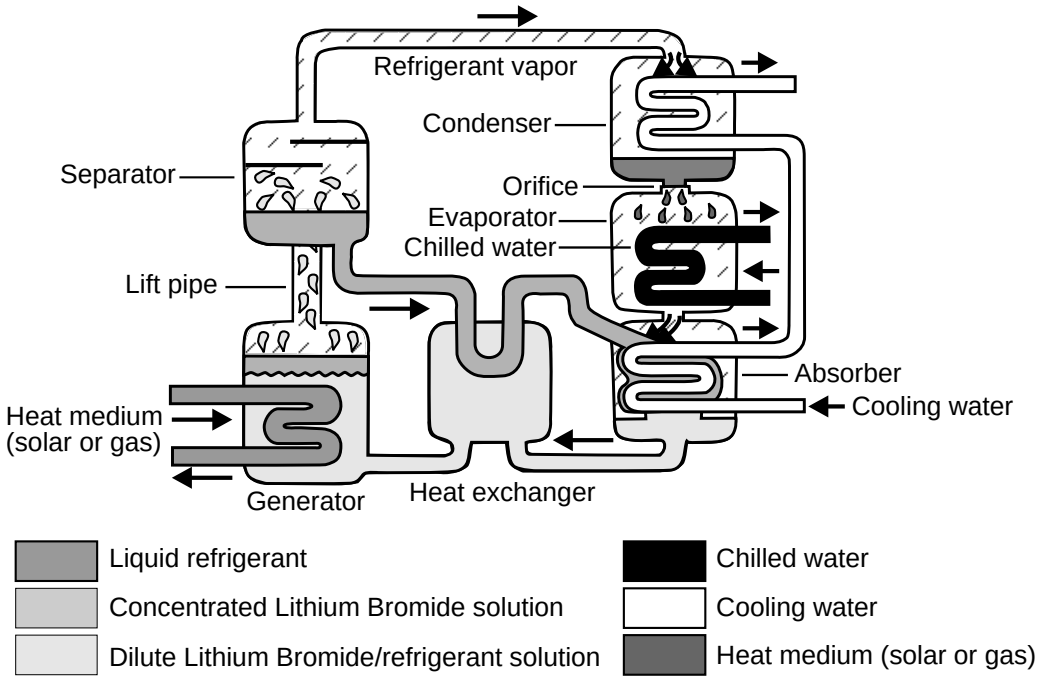
Appendix C: Absorption Cooling Technology

Single-Effect Absorption Chillers

Single-effect absorption-chiller systems consist of an evaporator, absorber, generator, separator, and condenser. They operate as follows:

- The evaporator generates chilled water at 4˚–10˚C (40˚–50˚F) that is pumped to one or more air-conditioning units in the air distribution system of the building. Chilled water is produced when refrigerant water at very low pressure extracts heat from the water to be chilled. As it absorbs heat, the refrigerant water vaporizes.
- The vaporized refrigerant water flows from the evaporator to the absorber. The absorber contains lithium bromide, which is capable of absorbing large quantities of refrigerant vapor on contact. The refrigerant vapor is absorbed by concentrated lithium bromide solution as it flows across the surface of the absorber coil.
- The diluted solution is preheated by a heat exchanger before being pumped to the generator. The generator boils the dilute refrigerant/lithium bromide solution so that the refrigerant and lithium bromide can be separated and recovered for reuse. Solar flat-plate, evacuated-tube or parabolic-trough collectors are used to heat water to 76.7˚–98.9˚C (170˚–210˚F), which is circulated through the generator to heat the refrigerant/lithium bromide solution. The solution boils under low pressure. The refrigerant vapor is raised to a high temperature and pressure so that it can reject the heat picked up in the evaporator. When sunlight is insufficient or unavailable to generate thermal energy for the generator, an auxiliary electric, natural gas, or steam subsystem is used.
- The boiled solution is then sent to the separator and into a condenser, where it collects on the surface of the cooling coil. Heat is removed by the cooling water and rejected through a cooling tower. Refrigerant liquid accumulates in the condenser and passes into the evaporator, starting the cycle anew.



Source: American Yazaki Corporation

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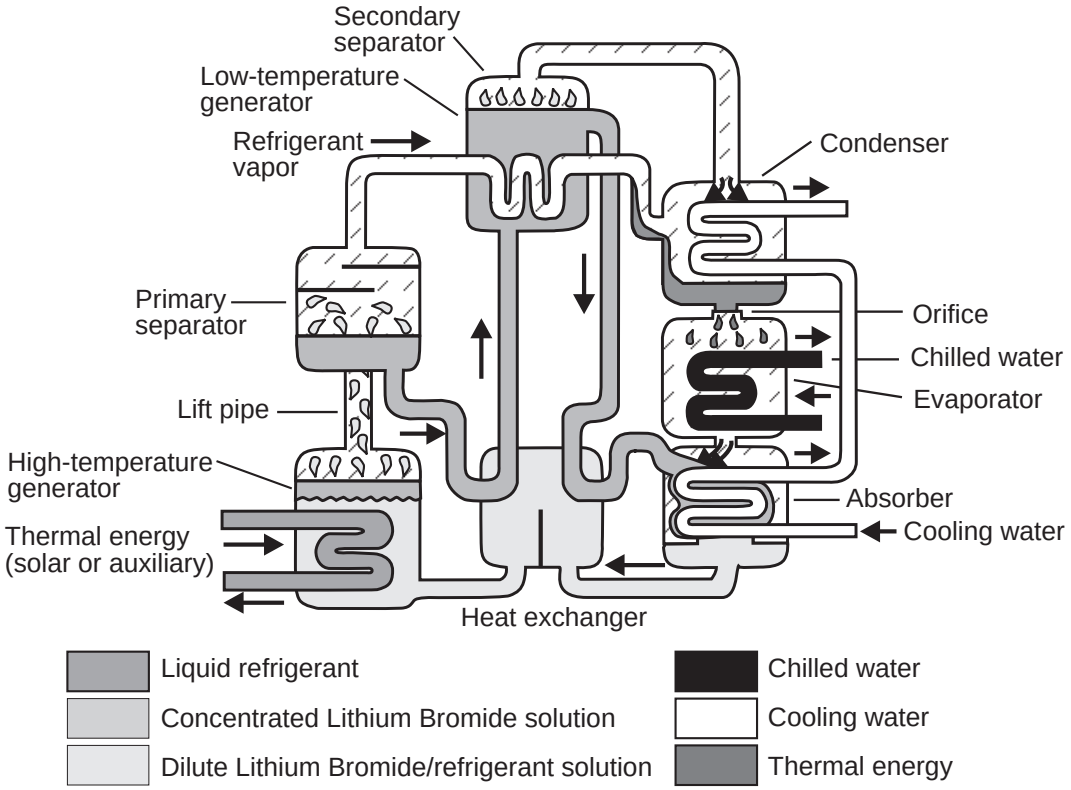
Double-Effect Absorption Chillers

Double-effect absorption-chiller systems use a high-temperature (HT) generator and a low-temperature (LT) generator to improve the thermodynamic efficiency of the absorption cooling cycle.

- Operation of the evaporator and the absorber are the same as in the single-effect system.
- The diluted lithium bromide/refrigerant solution flows from the absorber into the HT generator. There, it is boiled using thermal energy from solar collectors or an auxiliary subsystem. This drives the refrigerant vapor and semiconcentrated lithium bromide into the primary separator. From the separator, the lithium bromide solution flows to the heat exchanger, where it is precooled before flowing into the LT generator.
- The hot refrigerant vapor flows from the primary separator to the LT generator, where it surrenders its heat to the semiconcentrated lithium bromide solution. This decreases the temperature at which it enters the condenser to less than that of a single-effect system. Also, additional refrigerant is separated from the lithium bromide in the secondary separator, which further concentrates it.
- The concentrated lithium bromide is precooled by the heat exchanger before flowing back into the absorber.

The refrigerant vapor flows to the condenser where its heat is removed by cooling water and rejected through a cooling tower. Refrigerant liquid accumulates in the condenser and then passes into the evaporator, starting the cycle over.



Source: American Yazaki Corporation

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